What is claimed is:

1. A system for vessel segmentation, comprising:

at least one input adapter for receiving image data;

a processor in signal communication with the at least one input adapter;

a pre-processing unit in signal communication with the processor for pre-processing the received image data; and

a vessel segmentation unit in signal communication with the processor for segmenting vessels using pre-processed data.

2. A system as defined in Claim 1 wherein the image data is a computerized tomographic angiography ("CTA") data set, the pre-processing unit comprising:

a CTA pre-filtering portion in signal communication with the processor for pre-filtering the CTA data set;

an edgeness filtering portion in signal communication with the processor for calculating the boundary information; and

a multi-level vesselness computation portion in signal communication with the processor for computing the multi-level vesselness.

3. A system as defined in Claim 2, the multi-level vesselness computation portion comprising a Multum In Parvo ("MIP") volume pyramid portion.

4. A system as defined in Claim 2 wherein the CTA pre-filtering portion is automatic for enhancing the vesselness response in CTA data sets.

5. A system as defined in Claim 2 wherein the CTA pre-filtering portion is responsive to anatomic regions that are at least one of specified by a user and automatically determined.

6. A system as defined in Claim 2 wherein every voxel in the CTA dataset can be pre-assigned with a probability of being part of a vessel.

7. A system as defined in Claim 6 wherein the pre-assigned probability of a voxel being part of a vessel is determined by at least one of three-dimensional ("3D") shape, voxel intensity, derivatives of the intensity, and texture.

8. A system as defined in Claim 2 wherein the multi-level vesselness computation portion uses vesselness as a vessel enhancement method in CTA data sets to improve segmentation.

9. A system as defined in Claim 1, further comprising a display adapter (110) in signal communication with the processor for providing a visualization of vasculature responsive to the multi-level vesselness computation portion.

10. A system as defined in Claim 2 wherein the edgeness filtering portion computes the boundary information of objects.

11. A system as defined in Claim 1, the vessel segmentation unit having an integration portion for integrating vesselness and edgeness information to segment vessels using vesselness and edgeness.

12. A system as defined in Claim 1 wherein the vessel segmentation unit provides a separation of vasculature from non-vasculature such as bones and soft tissue.

13. A system as defined in Claim 1 wherein the vessel segmentation unit provides a segmentation of vasculature and other objects similar to vessels or tubes, such as a spinal column.

14. A system as defined in Claim 1 wherein the vessel segmentation unit provides a segmentation of non-vasculature such as bones and soft tissue.

15. A method of vessel segmentation, comprising:

receiving image data;

pre-processing the received data; and

segmenting vessels responsive to the pre-processed data.

16. A method as defined in Claim 15 wherein:

the image data is a computerized tomographic angiography ("CTA") data set; and

pre-processing includes at least one of pre-filtering the received data, computing the multi-level vesselness, and computing the edgeness.

17. A method as defined in Claim 15 wherein segmenting vessels is responsive to the computed vesselness and to the computed edgeness.

18. A method as defined in Claim 16 wherein computing the multi-level vesselness includes using a Multum In Parvo ("MIP") volume pyramid.

19. A method as defined in Claim 16 wherein pre-filtering the CTA data is automatic for enhancing the vesselness response in CTA data sets.

20. A method as defined in Claim 16 wherein pre-filtering the CTA data is responsive to anatomic regions that are at least one of specified by a user and automatically determined.

21. A method as defined in Claim 16 wherein every voxel in the CTA dataset is pre-assigned with a probability of being part of a vessel.

22. A method as defined in Claim 21 wherein the pre-assigned probability of a voxel being part of a vessel is determined by at least one of three-dimensional ("3D") shape, voxel intensity, derivatives of the intensity, and texture.

23. A method as defined in Claim 16 wherein the computation of multi-level vesselness uses vesselness as a vessel enhancement method in CTA data sets to improve segmentation.

24. A method as defined in Claim 15, further comprising providing a visualization of vasculature responsive to the computation of multi-level vesselness.

25. A method as defined in Claim 16 wherein computing the edgeness includes filtering boundary information of objects.

26. A method as defined in Claim 16 wherein the vessel segmentation unit segments vessels using vesselness and edgeness.

27. A method as defined in Claim 15 wherein the vessel segmentation unit provides a separation of vasculature from non-vasculature such as bones and soft tissue.

28. A method as defined in Claim 15 wherein the vessel segmentation unit provides a segmentation of vasculature and other objects similar to vessels or tubes, such as a spinal column.

29. A method as defined in Claim 15 wherein the vessel segmentation unit provides a segmentation of non-vasculature such as bones and soft tissue.

30. A method as defined in Claim 16, pre-filtering comprising:

maintaining a Gaussian shape vessel luminal profile;

adjusting the volume intensity so that the maximum intensity within the vessel lumen becomes the maximum intensity of the volume; and

normalizing the intensity to compare the vesselness from different locations.

31. A method as defined in Claim 16, pre-filtering comprising categorizing the CTA data into three ranges.

32. A method as defined in Claim 31 wherein the three ranges include an Ex-vessel Low (“ExL”) range including air, fat and soft tissue; an In-vessel (“In”) range including contrast enhanced vessel, low intensity bone and marrow; and an Ex-vessel High (“ExH”) range including bone and calcium.

33. A method as defined in Claim 16 wherein pre-filtering is set up as a roof-shaped curve.

34. A method as defined in Claim 16 wherein the edgeness filter computes the boundary information with a Gaussian filter.

35. A method as defined in Claim 15 wherein the vessel segmentation uses front propagation with vesselness and edgeness and includes checking a seed heap and marching the front interface outwards in response to at least one seed.

36. A method as defined in Claim 16 wherein the vessel segmentation uses a single-scale Hessian filter to estimate the primary direction in correspondence with the same scale as used to calculate the vesselness.

37. A method as defined in Claim 36 wherein at least one of the vesselness and speed volume is centralized, and a single-scale is used to track a vessel central axis ("VCA").

38. A method as defined in Claim 37 wherein the VCA is used as an initial front to segment a vessel.

39. A method as defined in Claim 38 wherein the VCA is trimmed when two central axes are close enough in space such that they can be merged into one central axis.

40. A method as defined in Claim 37, further comprising receiving a plurality of user clicks such that the VCA always follows the directions of the user clicks.

41. A method as defined in Claim 15, further comprising automatically extracting vessels in accordance with basic knowledge of anatomy responsive to at least one of approximate direction, curvature, and connectivity to other vessels.

42. A method as defined in Claim 15 wherein the image data includes a data set obtained from at least one of computerized tomographic angiography ("CTA"), magnetic resonance angiography ("MRA"), x-ray angiography ("XRA") and digital subtraction angiography ("DSA").

43. A program storage device readable by machine, tangibly embodying a program of instructions executable by the machine to perform program steps for vessel segmentation, the program steps comprising:

receiving image data;

filtering the received image data;

computing multi-level vesselness of the filtered image data;

computing edgeness of the filtered image data;

segmenting at least one vessel in response to the computed vesselness and edgeness.

44. A program storage device as defined in Claim 43, the program steps further comprising segmenting a vessel in correspondence with the computed multi-level vesselness for vesselness-based front propagation.